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EXAMINER

PHAM, THANHHA S

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 02/07/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/752,685

Applicant(s)

TRAPP, SHANE J.

Examiner

Thanhha Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11/27/01 and interview dated 1/30/02.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-70 is/are pending in the application.
- 4a) Of the above claim(s) 26-35 and 47-63 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-25, 36-46 and 64-70 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other:

## DETAILED ACTION

### *Election/Restrictions*

1. Claims 26-35 and 47-63 and withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to nonelected inventions, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 4 and interview dated 01/30/02 with Gabriela Coman.
2. Applicant's election without traverse of claims 1-25, 36-46 and 64-70 in Paper No. 4 and interview dated 01/30/02 is acknowledged.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 2, 8, 13-14, 21, 37, 43 and 64-70 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 2,

It is not clear how a self-aligned contact opening is formed

With respect to claim 8,

Line 1, "said contacting" lacking of antecedent basis should be changed to "said etching" (see claim 1)

With respect to claim 13,

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Lines 1-3, it is not clear where "sidewall spacers", "a gate stack" come from and are actually located. It is not clear how "a gate stack" and "sidewall spacers" are formed in the method of forming an opening in an insulative layer as being claimed.

With respect to claim 14,

Lines 1-3, it is not clear where "side wall spacers", "a gate stack" come from and are actually located. It is not clear how "a gate stack" and "side wall spacers" are formed in the method of forming an opening in an insulative layer as being claimed.

With respect to claim 21,

It is not clear which fluorocarbon is flowed into a reaction chamber at a flow rate of about 18 sccm, see specification page 13, only CF<sub>4</sub> is flowed at the flow rate of about 18 sccm.

With respect to claim 37,

Line 2, it is not clear how a self-aligned contact opening is formed in said insulative layer.

With respect to claim 43,

It is not clear where "said contact opening", "side wall spacers" and "a pair of adjacent gate stacks" come from; and how "said contact opening", "side wall spacers" and "a pair of adjacent gate stacks" are formed in process for forming an opening in an insulative layer as being claimed.

With respect to claim 64,

Lines 1-2, "a contact opening in an insulative layer between adjacent gate stacks formed over a substrate" renders the claim indefinite. It is not clear which element, "a

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contact opening" or "an insulative layer", is located between adjacent gate stacks. And what are formed over a substrate -- "a contact opening" or "an insulative layer" or "adjacent gate stacks"?

Lines 6-8, "to form a self-aligned contact opening in said insulative layer between said gate stacks without an etch stop" renders the claim indefinite. It is not clear what is formed between said gate stacks -- "a self-aligned contact opening" or "said insulative layer"? In addition, "said gate stacks" lacking of antecedent basis should be changed to "said adjacent gate stacks".

Line 10, it is not clear where "said opening" comes from or locates at. It is not clear that "said opening" refers back to "a contact opening" (line 1 of claim 64) or "a self-aligned contact opening" (line 6-7 of claim 64)

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-12, 15-23, and 36-42, as being best understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Ding et al [US 5,814,563].

Ding et al, figs 1-7 and col 1-13, discloses a method of forming an opening in an insulative layer (20, fig 1d) formed over a substrate (25,32,34,36, fig 1d) in a semiconductor device comprising:

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forming a patterned photoresist mask (40, fig 1d) over said insulative layer;  
etching said insulative layer through an aperture in said patterned resist layer wherein said opening is etched through to said substrate using a combination of ammonia and at least one fluorocarbon (CHF<sub>3</sub> and CF<sub>4</sub>) at a temperature of about 0-50°C (e.g. 50°C, see col 6 lines 51-67), a pressure of about 40-50 mtorr (e.g. 50 mtorr, see col 5 lines 45-65), flow rate ratio of fluorocarbon:ammonia of about 4:1-10:1 (e.g. 6:1, see col 7 lines 44-62), flow rate of CHF<sub>3</sub> of about 35-45 sccm (e.g. 40 sccm, col 10 lines 24-26), flow rate of CF<sub>4</sub> of about 15-20 sccm (e.g. 18 sccm, col 10 lines 31-33); wherein said step of etching is performed without an etch stop.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-25, 36-46 and 64-70, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al [US 6,140,168] in view of Ding et al [US 5,814,563].

Tan et al, figs 1's and col 1-4, discloses a method for forming a self-aligned contact opening (124, fig 1D) in an insulative layer (114b) formed over a substrate comprising steps:

providing the substrate (100, fig 1A) comprising adjacent gate stacks being formed thereon, the adjacent gates stacks comprising opposed side wall spacers (108) which have been formed over the adjacent gate stacks;

forming the insulative layer (114, fig 1B) over the substrate, the adjacent gate stacks and the side wall spacers which have been formed over the adjacent gate stacks; and

forming a patterned photoresist mask layer (116, fig 1B) over said insulative layer;

contacting and etching the insulative layer through an aperture (120, fig 1C-1D) in the patterned photoresist mask layer, using a plasma etchant mixture comprising fluorocarbon ( $\text{CHF}_3$  and  $\text{CF}_4$ , col 3 lines 42-55) so as to form the self-aligned contact opening (124, fig 1D) in the insulative layer, the self-aligned contact opening being located between the adjacent gate stacks and the opposed side wall spacers aligning the self-aligned contact opening to the substrate; and

removing the patterned photoresist mask layer after said contacting and etching.

Tan et al does not teach: 1) using the plasma etchant mixture comprising said fluorocarbon and ammonia to form the self-aligned contact opening at a temperature of about  $-50$  to  $80^\circ\text{C}$  without an etch stop and further forms a protective layer over the opposed side wall spacers of the adjacent gate stacks; and 2) depositing a conductive plug inside said self-aligned contact such that said conductive plug is separated from said side opposed side wall spacers by said protective layer.

Regarding to 1), Ding et al teaches using ammonia in addition to fluorocarbon for plasma etching the insulative layer at a temperature of about  $-50$  to  $80^{\circ}\text{C}$  with a high etch rate and an improved etch selectivity. Ding et al also teaches using the plasma etchant mixture comprising fluorocarbon and ammonia would form an opening with a protective layer being formed on side wall of the opening. It would have been obvious for those skilled in the art to combine the teaching of Ding et al to the process of Tan et al to use the plasma etchant mixture comprising fluorocarbon and ammonia to etch the self-aligned contact at the temperature of  $-50$  to  $80^{\circ}\text{C}$  without an etch stop. In addition, those skilled in the art would recognize that combination of the process of Tan et al in view of Ding et al will form a protective layer over the opposed side wall spacers in the self-aligned contact opening.

Regarding to 2), depositing the conductive plug inside the self-aligned contact opening is well-known in the art for forming electrical connection in a semiconductor device. In addition, Tan et al teaches forming a self-aligned contact opening is for forming electrical connection between source/drain region and metal layer [see col 2 lines 15-23]. It would have been obvious for those skilled in the art to have limitation 2) in the process of Tan et al in view of Ding et al for forming the conductive plug in a semiconductor device to provide electrical connection between source/drain region to certain location of the semiconductor device to operate the device.

With respect to claim 19, using the fluorocarbons comprising  $\text{CF}_4$ ,  $\text{CHF}_3$  and  $\text{C}_2\text{H}_2\text{F}_2$  is well-known in the art for etching the insulative layer. The selection of a known material based on its suitability for its intended use supported a prima facie



obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.).

With respect to claims 4-7, 15-17, 20-25, 39-41, 44-45, 65-70, claimed ranges of temperature, flow rates, flow rate ratios in the etching steps are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller*, the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of

proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

*In re Aller* 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586

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(CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, one of ordinary skill in the requisite art at the time of invention was made would have used any ranges of temperature, flow rates, flow rate ratio range suitable to the method in process of Tan et al in view of Ding et al in order to optimize the process.

6. Claims 1-25, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Blalock et al [US 5,286,344] in the view of Ding et al [US 5,814,563].

Blalock et al, figs 1-2 and col 1-9, discloses a method of forming an opening in an insulative layer formed over a substrate in a semiconductor device comprising plasma etching the insulative layer (14, fig 2) with at least one fluorocarbon (CF<sub>4</sub>, CHF<sub>3</sub> and CH<sub>2</sub>F<sub>2</sub>) to form said opening.

Blalock et al does not teaching using ammonia in addition to fluorocarbon etchant.

Ding et al teaches using ammonia in addition to fluorocarbon for plasma etching the insulative layer a better etch rate and a good etch selectivity. It would would have

been obvious for those skilled in the art to combine the teaching of Ding et al to the process of Blalock et al to use the plasma etchant mixture comprising fluorocarbon and ammonia to etch the opening in the semiconductor device without an etch stop, since ammonia can absorb underlying layer to increase etch rate, for reducing production cost.

With respect to claims 4-7, 15-17, 20-25, claimed ranges of temperature, flow rates, flow rate ratios in the etching step are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. See *In re Aller* 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chaudhuri Olik can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703)

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308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham  
February 5, 2002



Tuan H. Nguyen  
Primary Examiner